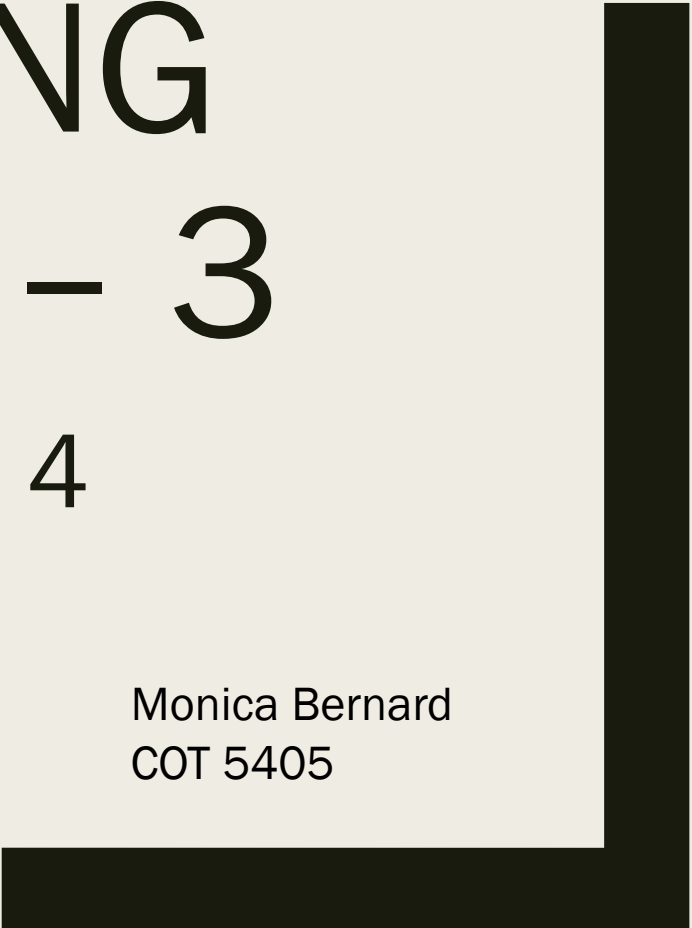# PROGRAMMING ASSIGNMENT – 3

Chapter 4, Question - 4

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COT 5405

Pseudocode for both Brute Force and Optimized algorithms with time and space complexity

Brute Force Solution:

For n from 1 to 10: ⟹ O(n)
Generate S, S_opt and S_prime
   for length of S_opt: ⟹ O(n)
      Search S_prime in S_opt starting from the 0th index
      Break out of the loop when a subset is found
      Increment index by 1.

Nested for loops result with a time **complexity of O(n²)**
Space Complexity is O(n) since variable n is increased linearly with time.

Optimized Solution:

For n from 1 to 1000: ⟹ O(n)
   Generate S, S_opt, S_prime
   SearchList= Consider first element of S_prime and store all indexes in S_opt that has this element
   for length of SearchList: ⟹ O(n)
      Check if the elements after the index of interest are same as the elements in S_prime
      Break out of the loop when a subset is found
      increment to the next index

Brute Force Results for n = 1,2,3....10

```
n:1
S:        Buy Reddit
S_opt:    Buy Reddit
S_prime: Buy Yahoo

Is S' a subset of S_opt?: False


n:2
S:        Buy Amazon, Buy Facebook
S_opt:    Buy Amazon, Buy Facebook
S_prime: Buy Amazon

Is S' a subset of S_opt?: True

n:3
S:        Buy Oracle, Buy Oracle, Buy eBay
S_opt:    Buy Oracle, Buy eBay
S_prime: Buy Facebook, Buy Google

Is S' a subset of S_opt?: False

n:4
S:        Buy Yahoo, Buy Google, Buy Reddit, Buy Yahoo
S_opt:    Buy Yahoo, Buy Google, Buy Reddit, Buy Yahoo
S_prime: Buy Yahoo, Buy eBay, Buy Reddit

Is S' a subset of S_opt?: False

n:5
S:        Buy Amazon, Buy Reddit, Buy Reddit, Buy Microsoft, Buy eBay
S_opt:    Buy Amazon, Buy Reddit, Buy Microsoft, Buy eBay
S_prime: Buy Microsoft, Buy Instagram, Buy Amazon

Is S' a subset of S_opt?: False

n:6
S:        Buy Apple, Buy Yahoo, Buy eBay, Buy Microsoft, Buy Microsoft, Buy Apple
S_opt:    Buy Apple, Buy Yahoo, Buy eBay, Buy Microsoft, Buy Apple
S_prime: Buy Google, Buy Reddit, Buy Apple

Is S' a subset of S_opt?: False

n:7
S:        Buy eBay, Buy Apple, Buy Facebook, Buy Apple, Buy Facebook, Buy Amazon, Buy Apple
S_opt:    Buy eBay, Buy Apple, Buy Facebook, Buy Apple, Buy Facebook, Buy Amazon, Buy Apple
S_prime: Buy Oracle, Buy Facebook, Buy Microsoft

Is S' a subset of S_opt?: False

n:8
S:        Buy eBay, Buy Reddit, Buy Microsoft, Buy Instagram, Buy Microsoft, Buy Amazon, Buy Yahoo, Buy Apple
S_opt:    Buy eBay, Buy Reddit, Buy Microsoft, Buy Instagram, Buy Microsoft, Buy Amazon, Buy Yahoo, Buy Apple
S_prime: Buy Facebook, Buy eBay, Buy Oracle

Is S' a subset of S_opt?: False

n:9
S:        Buy Reddit, Buy Yahoo, Buy eBay, Buy Google, Buy Oracle, Buy eBay, Buy Amazon, Buy Facebook, Buy eBay
S_opt:    Buy Reddit, Buy Yahoo, Buy eBay, Buy Google, Buy Oracle, Buy eBay, Buy Amazon, Buy Facebook, Buy eBay
S_prime: Buy Microsoft, Buy Yahoo, Buy Facebook

Is S' a subset of S_opt?: False

n:10
S:        Buy Facebook, Buy Amazon, Buy Amazon, Buy Instagram, Buy Facebook, Buy Reddit, Buy Microsoft, Buy Reddit, Buy Instagram, Buy Reddit
S_opt:    Buy Facebook, Buy Amazon, Buy Instagram, Buy Facebook, Buy Reddit, Buy Microsoft, Buy Reddit, Buy Instagram, Buy Reddit
S_prime: Buy Oracle, Buy Microsoft, Buy Reddit

Is S' a subset of S_opt?: False
```
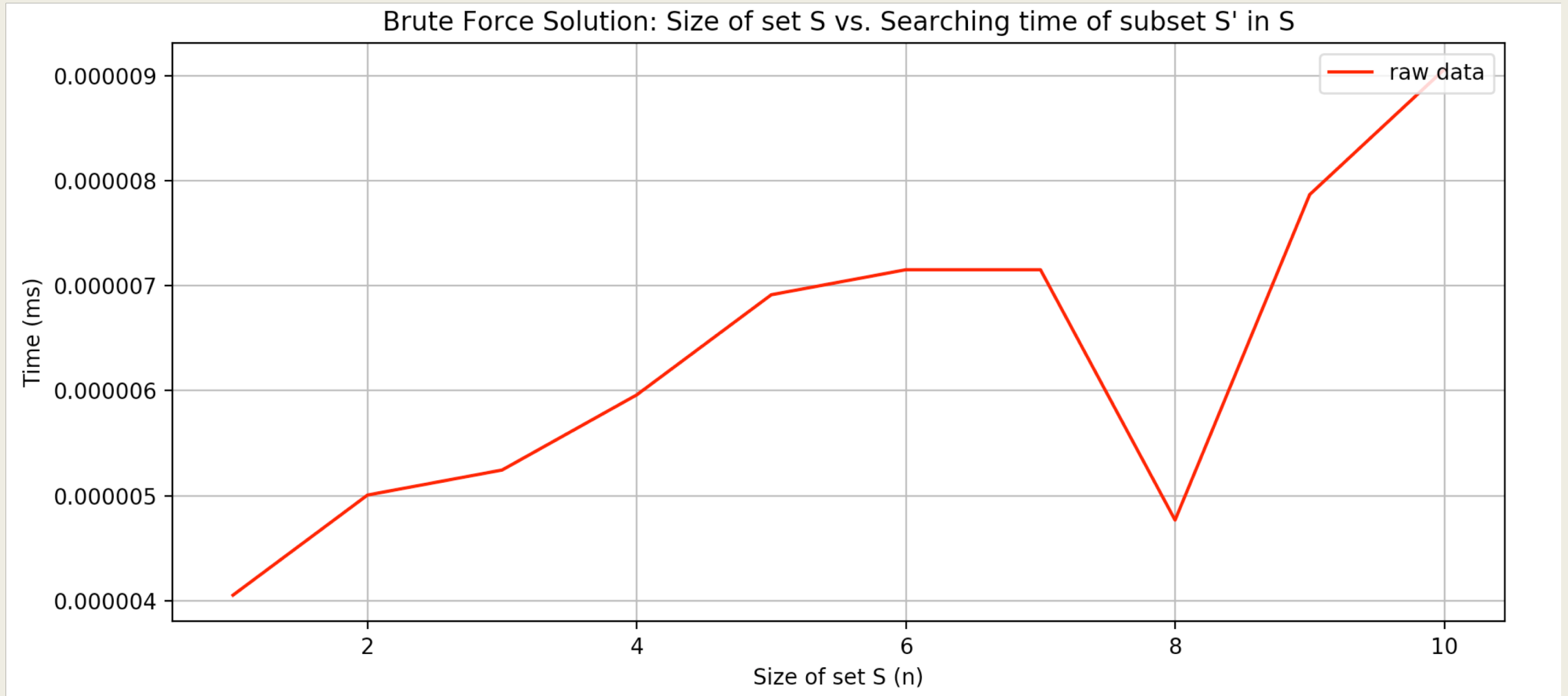
Brute Force: Time taken to search through S_opt to find a subset S_prime for n = 1,2,...10

Brute Force Solution: Size of set S vs. Searching time of subset S' in S

Some screenshots of a test run to validate optimized solution (n = 89, 104 and 145)

```
n:89
S:       Buy Microsoft, Buy Reddit, Buy Yahoo, Buy Microsoft, Buy
Amazon, Buy Oracle, Buy Microsoft, Buy Google, Buy Amazon, Buy
Facebook, Buy eBay, Buy Amazon, Buy eBay, Buy Reddit, Buy Yahoo, Buy
Yahoo, Buy Oracle, Buy Facebook, Buy Amazon, Buy eBay, Buy Google, Buy
Oracle, Buy Facebook, Buy Apple, Buy Facebook, Buy Oracle, Buy Oracle,
Buy Amazon, Buy Oracle, Buy eBay, Buy Oracle, Buy Amazon, Buy
Facebook, Buy Reddit, Buy eBay, Buy Yahoo, Buy eBay, Buy Google, Buy
eBay, Buy Google, Buy Facebook, Buy eBay, Buy Google, Buy Instagram,
Buy Reddit, Buy Google, Buy eBay, Buy eBay, Buy Facebook, Buy
Instagram, Buy Oracle, Buy Microsoft, Buy Yahoo, Buy Google, Buy
Facebook, Buy Amazon, Buy Yahoo, Buy Reddit, Buy Instagram, Buy Apple,
Buy Google, Buy Reddit, Buy Apple, Buy Instagram, Buy Facebook, Buy
Microsoft, Buy Apple, Buy Yahoo, Buy Microsoft, Buy Reddit, Buy
Oracle, Buy Google, Buy Facebook, Buy Reddit, Buy Reddit, Buy
Facebook, Buy Amazon, Buy Oracle, Buy eBay, Buy Yahoo, Buy Reddit, Bu
Google, Buy eBay, Buy Google, Buy Instagram, Buy Facebook, Buy eBay,
Buy Google, Buy eBay
S_opt:   Buy Microsoft, Buy Reddit, Buy Yahoo, Buy Microsoft, Buy
Amazon, Buy Oracle, Buy Microsoft, Buy Google, Buy Amazon, Buy
Facebook, Buy eBay, Buy Amazon, Buy eBay, Buy Reddit, Buy Yahoo, Buy
Oracle, Buy Facebook, Buy Amazon, Buy eBay, Buy Google, Buy Oracle,
Buy Facebook, Buy Apple, Buy Facebook, Buy Oracle, Buy Amazon, Buy
Oracle, Buy eBay, Buy Oracle, Buy Amazon, Buy Facebook, Buy Reddit,
Buy eBay, Buy Yahoo, Buy eBay, Buy Google, Buy eBay, Buy Google, Buy
Facebook, Buy eBay, Buy Google, Buy Instagram, Buy Reddit, Buy Google
Buy eBay, Buy Facebook, Buy Instagram, Buy Oracle, Buy Microsoft, Buy
Yahoo, Buy Google, Buy Facebook, Buy Amazon, Buy Yahoo, Buy Reddit,
Buy Instagram, Buy Apple, Buy Google, Buy Reddit, Buy Apple, Buy
Instagram, Buy Facebook, Buy Microsoft, Buy Apple, Buy Yahoo, Buy
Microsoft, Buy Reddit, Buy Oracle, Buy Google, Buy Facebook, Buy
Reddit, Buy Facebook, Buy Amazon, Buy Oracle, Buy eBay, Buy Yahoo, Bu
Reddit, Buy Google, Buy eBay, Buy Google, Buy Instagram, Buy Facebook
Buy eBay, Buy Google, Buy eBay
S_prime: Buy Facebook, Buy Reddit, Buy eBay

Is S' a subset of S_opt?:True
```

```
n:104
S:       Buy Microsoft, Buy eBay, Buy Microsoft, Buy Yahoo, Buy
Oracle, Buy Amazon, Buy Apple, Buy Microsoft, Buy Microsoft, Buy
Instagram, Buy Google, Buy Facebook, Buy Microsoft, Buy eBay, Buy
Amazon, Buy Microsoft, Buy Google, Buy Facebook, Buy Instagram, Buy
Instagram, Buy Facebook, Buy Oracle, Buy Oracle, Buy Amazon, Buy eBay
Buy Reddit, Buy Instagram, Buy Amazon, Buy Apple, Buy Amazon, Buy
Facebook, Buy Google, Buy Google, Buy Google, Buy Instagram, Buy eBay
Buy Reddit, Buy Microsoft, Buy Instagram, Buy Yahoo, Buy Google, Buy
Yahoo, Buy eBay, Buy Facebook, Buy Facebook, Buy Microsoft, Buy
Oracle, Buy Apple, Buy Yahoo, Buy Facebook, Buy Instagram, Buy Reddit
Buy Google, Buy Google, Buy Yahoo, Buy Microsoft, Buy Instagram, Buy
Microsoft, Buy Google, Buy Yahoo, Buy Yahoo, Buy Instagram, Buy eBay,
Buy Microsoft, Buy Amazon, Buy Google, Buy Facebook, Buy Amazon, Buy
Yahoo, Buy Instagram, Buy eBay, Buy Instagram, Buy Facebook, Buy
Reddit, Buy Microsoft, Buy Reddit, Buy Apple, Buy Amazon, Buy
Instagram, Buy Google, Buy Google, Buy Apple, Buy Oracle, Buy Reddit,
Buy Microsoft, Buy Amazon, Buy eBay, Buy Microsoft, Buy Facebook, Buy
Instagram, Buy Microsoft, Buy eBay, Buy Amazon, Buy Instagram, Buy
Google, Buy Instagram, Buy Facebook, Buy eBay, Buy Yahoo, Buy Amazon,
Buy Apple, Buy Instagram, Buy Apple, Buy Facebook
S_opt:   Buy Microsoft, Buy eBay, Buy Microsoft, Buy Yahoo, Buy
Oracle, Buy Amazon, Buy Apple, Buy Microsoft, Buy Instagram, Buy
Google, Buy Facebook, Buy Microsoft, Buy eBay, Buy Amazon, Buy
Microsoft, Buy Google, Buy Facebook, Buy Instagram, Buy Facebook, Buy
Oracle, Buy Amazon, Buy eBay, Buy Reddit, Buy Instagram, Buy Amazon,
Buy Apple, Buy Amazon, Buy Facebook, Buy Google, Buy Instagram, Buy
eBay, Buy Reddit, Buy Microsoft, Buy Instagram, Buy Yahoo, Buy Google,
Buy Yahoo, Buy eBay, Buy Facebook, Buy Microsoft, Buy Oracle, Buy
Apple, Buy Yahoo, Buy Facebook, Buy Instagram, Buy Reddit, Buy Google,
Buy Yahoo, Buy Microsoft, Buy Instagram, Buy Microsoft, Buy Google,
Buy Yahoo, Buy Instagram, Buy eBay, Buy Microsoft, Buy Oracle, Buy
Apple, Buy Yahoo, Buy Facebook, Buy Instagram, Buy Reddit, Buy Google,
Buy Yahoo, Buy Microsoft, Buy Instagram, Buy Microsoft, Buy Google,
Buy Yahoo, Buy Instagram, Buy eBay, Buy Microsoft, Buy Amazon, Buy
Google, Buy Facebook, Buy Amazon, Buy Yahoo, Buy Instagram, Buy eBay,
Buy Instagram, Buy Facebook, Buy Reddit, Buy Microsoft, Buy Reddit,
Buy Apple, Buy Amazon, Buy Instagram, Buy Google, Buy Apple, Buy
Oracle, Buy Reddit, Buy Microsoft, Buy Amazon, Buy eBay, Buy
Microsoft, Buy Facebook, Buy Instagram, Buy Microsoft, Buy eBay, Buy
Amazon, Buy Instagram, Buy Google, Buy Instagram, Buy Facebook, Buy
eBay, Buy Yahoo, Buy Amazon, Buy Apple, Buy Instagram, Buy Apple, Buy
Facebook
S_prime: Buy Yahoo, Buy Instagram, Buy Reddit

Is S' a subset of S_opt?:False
```

```
S_opt:   Buy Apple, Buy Google, Buy eBay, Buy Facebook, Buy Reddit,
Buy Apple, Buy Instagram, Buy eBay, Buy Oracle, Buy Apple, Buy Amazon,
Buy Reddit, Buy Apple, Buy Amazon, Buy Reddit, Buy Yahoo, Buy eBay,
Buy Oracle, Buy eBay, Buy Amazon, Buy Google, Buy Oracle, Buy Apple,
Buy Instagram, Buy Amazon, Buy Apple, Buy Facebook, Buy Oracle, Buy
Reddit, Buy Google, Buy Instagram, Buy Reddit, Buy Oracle, Buy
Instagram, Buy Amazon, Buy Google, Buy Oracle, Buy eBay, Buy Google,
Buy Amazon, Buy Apple, Buy eBay, Buy Apple, Buy Instagram, Buy Apple,
Buy Oracle, Buy eBay, Buy Microsoft, Buy Yahoo, Buy Facebook, Buy
Instagram, Buy Oracle, Buy eBay, Buy Microsoft, Buy Apple, Buy Oracle,
Buy Microsoft, Buy Apple, Buy Facebook, Buy Yahoo, Buy Instagram, Buy
eBay, Buy Google, Buy Facebook, Buy Reddit, Buy Oracle, Buy Facebook,
Buy Instagram, Buy Oracle, Buy Reddit, Buy Apple, Buy Amazon, Buy
Facebook, Buy Oracle, Buy Amazon, Buy Instagram, Buy Apple, Buy
Reddit, Buy Apple, Buy Amazon, Buy Facebook, Buy Reddit, Buy Facebook,
Buy Oracle, Buy Reddit, Buy Microsoft, Buy eBay, Buy Microsoft, Buy
Apple, Buy Oracle, Buy Instagram, Buy Apple, Buy Microsoft, Buy eBay,
Buy Facebook, Buy Reddit, Buy eBay, Buy Reddit, Buy Facebook, Buy
Google, Buy Reddit, Buy Amazon, Buy Instagram, Buy Facebook, Buy
Instagram, Buy Facebook, Buy Google, Buy Apple, Buy Facebook, Buy
Microsoft, Buy Oracle, Buy Facebook, Buy eBay, Buy Google, Buy
Facebook, Buy Oracle, Buy eBay, Buy Amazon, Buy Yahoo, Buy Microsoft,
Buy Reddit, Buy Apple, Buy eBay, Buy Reddit, Buy Oracle, Buy Yahoo,
Buy Microsoft, Buy Yahoo, Buy Instagram, Buy Reddit, Buy Amazon, Buy
Oracle, Buy Google, Buy Microsoft, Buy Amazon, Buy Facebook, Buy eBay
S_prime: Buy Oracle, Buy Yahoo, Buy Microsoft

Is S' a subset of S_opt?:True
n:146
S:       Buy Facebook, Buy Instagram, Buy Reddit, Buy Amazon, Buy
eBay, Buy Oracle, Buy eBay, Buy Instagram, Buy Microsoft, Buy Oracle,
Buy Microsoft, Buy Instagram, Buy Yahoo, Buy Reddit, Buy Amazon, Buy
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Optimized Solution: Time taken to search through S_opt to find a subset S_prime for n = 1,2,...1000